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ABSTRACT

A study examined technology gaps in rural schools and computer accessibility and Internet use by teachers. Findings from surveys of 205 teachers in the rural Ozarks region of Missouri indicate significant differences in Internet accessibility among rural schools with a low, middle, or high technology status; and no significant interaction effects on teacher Internet use between school technology status and teacher computer accessibility. Upgrading school technology was a significant factor in Internet utilization; and technology upgrading was a key factor in rural school improvement. The lack of a significant gap in Internet use between teachers who had access to computers at zero versus one location suggests that without computing facilities both at teachers' homes and at schools, technology investment at school is unlikely to result in substantial improvement of Internet utilization by teachers. Significant differences in Internet use among teachers who had computer access at more than one location indicates that given teacher ownership of computers at home, multiple convenient locations for Internet use within schools encourage teacher Internet use. Recommendations include making computers more available to teachers and providing professional development activities that enrich teacher knowledge of computer and Internet use. (Contains 11 references, 2 tables, and 2 footnotes.) (TD)

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An Examination of Digital Dividing Factors on Teachers' Access to Internet Resources in Rural Schools

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An Examination of Digital Dividing Factors

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Abstract

The Internet technology has established an information highway to break geographical isolations at rural schools. As part of a project funded by the U.S. Department of Education, empirical data have been gathered from the rural Ozarks region to disentangle factors that have significant impact on teachers' access to the Internet resources. The results indicate significant differences of the Internet accessibility among the rural schools with a low, middle, or high technology status. Another significant factor hinges on the number of locations with computers available for teacher use. These empirical findings are interpreted in a broad context of digital divide in the underserved rural setting.

An Examination of Digital Dividing Factors on Teachers' Access to Internet Resources in Rural Schools

Access to the Internet resources is one of the educational priorities proposed by the U.S. government (http://www.ed.gov/inits.html). According to the most recent statistics, 95 percent schools are connected to the Internet by year 2000. Meanwhile, it is reported that "The situation in classrooms is different, with 63 percent now connected, up from just 3 percent in 1994" (MSNBC, 2000, p. 2). Clinton (2000b) acknowledged that "We also know that people who live in rural areas, regardless of their race, are far, far less likely to own computers, and to be wired to the Net -- even though they, in some ways, need it more than anybody else because of their physical isolation" (p. 3).

As part of the effort to close the digital divide, the U.S. Department of Education funded a $2.8 million grant to enhance teacher preparation in the rural Ozarks region of Missouri. In partnership with the Southwest Missouri State University (SMSU), the federal grant has resulted in some profound changes in rural schools and school districts during the 1999-2000 academic year. Network facilities, such as Centra99 and videoconferencing systems, have been installed at remote schools, and professional development workshops have been offered to enhance technological skills of school project coordinators. To facilitate assessment of the current status of technology preparation, professionals from six participating schools[1] completed a *School Technology and Readiness* (StaR) chart (http://www.ceoforum.org). Meanwhile, a total

of 205 teachers responded to questions (survey created by Dr. Chin Tang Liu, Temple University) regarding their computer and Internet access at home and in the school. The empirical data have been merged between school and teacher levels to disentangle factors that have significant influences on teachers' access to the Internet resources. Selection of the empirical factors is grounded on the existing research literature, particularly those related to schools in underserved, rural regions.

Literature Review

Access to the Internet becomes increasingly important for full participation in America's economic, political, and social life (http://www.ed.gov/Technology/digdiv.html). In particular, "The Internet eliminates geography as limiting factor. Information can be gleaned from libraries, museums, research centers, and educational institutions all over the world" (Thornburg, 1999, p. 5). Given the availability of vast education resources, Clinton (2000b) projected, "Next thing we want to do is bring high-speed networks to underserved communities" (p. 5).

The digital divide among the communities has been inevitably reflected in school settings. According to the National Center for Education Statistics (NCES, 2000),

> Differences by school characteristics remain regarding Internet access in instructional rooms. ... The percentage of instructional rooms with Internet access in public schools with high concentrations of poverty did not increase between 1998 and 1999, while there were increases in the percentage of connected instructional rooms in schools with lower concentrations of poverty. (p. 1)

Limited by the local resources, not all the digital lin s have channeled the Internet access into classrooms (MSNBC, 2000). The technology status depends on four aspects, *hardware, connectivity, digital content*, and *professional development*. These factors

have been incorporated in the STaR chart (see Appendix 1), an instrument developed by the CEO Forum (http://www.ceoforum.org). Kalme (1999) recollected,

> Rather than define what constitutes Computer Literacy directly, the CEO Forum on Education and Technology builds on the "Four Pillars", hardware, connectivity, digital content, and professional development, identified by the President of the United States in his 1996 Technology Literacy Challenge as the foundation for bringing Computer Literacy to Americ a's schools. That is: every school must have adequate hardware for instructional use; all schools must be connected to the Internet; teachers must be provided with the appropriate content to integrate into their curricula; teachers must be equipped with the necessary skills to integrate the technology into the curriculum. This is made more precise through the School Technology and Readiness (STaR) Chart, which provides a measure of progress in the four areas of hardware, connectivity, digital content, and professional development, as well as how well these four areas are integrated into a whole. Based on this measure, schools are then broadly classified into four groups of readiness: Low Technology, Mid Technology, High Technology, and Target Technology. (p. 3)

Fulton (2000) noted, "The Teacher Preparation STaR Chart was developed with assistance of a wide group of stakeholders, including deans, faculty members, students, superintendents, educators, and business community members" (p. 1). An Internet search on July 20, 2000 indicated that the instrument has been employed to assess school technology status in seventeen states[2], as well as Australia, Canada, and the United Kingdom. In this study, reliability of the survey responses has been checked using Cronbach's α coefficient. On basis of the survey data collected from 205 teachers, the reliability index is 0.96. The assessment indicates that the participating schools are classified into low, middle, and high technology categories.

The Internet technology has a substantial impact on rural school education. Thornburg (1999) asserted, "In addition to providing access to reference materials on virtually any academic subject, on-line communication tolls can help educators collaborate and converse with peers all over the world" (p. 6). However, rural schools in

the Ozarks region of Missouri are located in an under-served community. The need of accessing the Internet resources has driven teachers to seek computer connections at various locations, including school offices, classrooms, and home workplaces. In this study, the computer accessibility is represented by the number of locations that allow teachers to use computers. Information at the teacher level has been articulated with the STaR chart results to triangulate the nature of digital divide among schools of the rural Ozarks community.

Research Questions

The digital divide leads policy makers, educators, and researchers to investigate technology gaps in rural schools (Jaber & Moore, 1999). The school improvement hinges on the technological resources in school and the computer accessibility by teachers. Questions that guided this study are:

1. Are there significant interactions between the resource and accessibility factors on the use of Internet resources by teachers?
2. What is the impact of computer accessibility on teachers' Internet use?
3. What is the influence of school technological status on the Internet use?

Methods

Thornburg (1999) reported that "Households with incomes of $75,000 and higher were more than twenty times more likely to have access to the Internet than those at the lowest income levels, and more than nine times as likely to have a computer at home" (p. 11). In line with the federal survey approach, the Internet and computer accessibility has been differentiated in the survey database. In addition to the school technology status

information from the STaR chart instrument, teachers' computer access is another factor influencing the Internet access. Given the existence of two independent variables (school technology resources & teacher computer access) and one dependent variable (teacher Internet access), two-way ANOVA is employed to examine the effect of interaction between the school and teacher factors (Question 1). Specific influences of the digital dividing factors at each level are analyzed through Tukey's post hoc tests (Questions 2 & 3). Because not all teachers have family incomes at or beyond $75,000, this empirical study may help confirm/disconfirm a speculation that factors at teacher and school levels have a joint impact on an effective use of Internet in instruction (Jaber, & Moore, 1999).

Results

Findings from the two-way ANOVA are presented in Table 1. The post hoc test results are listed in Table 2.

Table 1

Two-way ANOVA results on the factors of Internet access

Source	DF	Sum of Square	Mean Square	F Value	Pr > F
Sch_tech	2	5.13272872	2.56636436	4.81	0.0091
comp_acc	3	24.28441552	8.09480517	15.19	<.0001
sch_tech*comp_acc	5	2.39373893	0.47874779	0.90	0.4834
Error	194	103.4076324	0.5330290		
Total	204	167.7756098			

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Table 2

Results of post hoc tests on the factors of Internet access

Level	HSD	Tukey Grouping	
School Technology Status	3.34	MID - HIG	***
		MID - LOW	***
		HIG - MID	***
		HIG - LOW	***
		LOW - MID	***
		LOW - HIG	***
Teacher Computer Access	3.66	3 loc - 2 loc	***
		3 loc - 1 loc	***
		3 loc - 0 loc	***
		2 loc - 3 loc	***
		2 loc - 1 loc	***
		2 loc - 0 loc	***
		1 loc - 3 loc	***
		1 loc - 2 loc	***
		1 loc - 0 loc	
		0 loc - 3 loc	***
		0 loc - 2 loc	***
		0 loc - 1 loc	

Note: Comparisons significant at the 0.05 level are indicated by ***.

Discussions

Inspection of the ANOVA table suggests significant differences of the Internet accessibility among the rural schools with a low, middle, or high technology status (Table 1). Apparently, enhancement of the technology investment remains a funding priority in the isolated regions. Baldwin (1999) reported an effective approach adopted by a rural school that provides "a laptop computer and Internet access from home through the school's server" (p. 10). This kind of approach usually requires a tremendous amount of financial resources that few rural schools can afford. Consequently, the effect of the outreaching is unlikely to be sustained in most isolated regions. With a $2.81 million grant from the U.S. Department of Education, the Ozarks Partner-ship Teacher Enhancement Initiative (OPTEI) has installed network connections and videoconference facilities at six rural schools or school districts in the southern Missouri region. Nonetheless, purchase of teachers' home computers is not supported by the grant budget.

As a result, no significant interaction effects on teachers' Internet use have been found between the school technology status and the teacher computer accessibility (Table 1).

Still, results of this investigation indicate that upgrading school technology is a significant factor of the Internet utilization (Table 1). According to the recent education statistics, "Almost half of U.S. public schools are in rural areas and small towns. ... About half of rural and small-town schools report at least one facility problem" (Dewees, 1999, p. 1). Beckner and Barker (1994) further elaborated,

> The National Congress on Rural Education identified barriers to the improvement of rural education in the areas of funding, provision for special circumstances of rural education, staff development, adequate and qualified teaching personnel, administrator work overload, and remedial education. Technology can overcome or alleviate these barriers. (p. 1)

Given the existence of competing demands for the limited school resources, this study has confirmed the key role of technology upgrading in rural school improvement.

Another significant factor identified from this investigation is the number of locations with computers available for teacher use (Table 1). Results of the post hoc test suggest no significant gap of the Internet use among the teachers who had zero or one location access to computers (Table 2). The limit of one location typically represents a situation in which teachers do not have the flexibility of computer access at different places. School technology upgrading may have provided the Internet access at the only location. Since the Internet resources are available 24 hours a day and 7 days a week, teachers should be able to gather the Internet instructional resources using their home computers. Without the computing facilities at both locations, the technological investment at school is unlikely to result in a substantial improvement of Internet utilization by teachers.

As the ongoing drop of computer price continues in recent years, teachers' willingness of purchasing a home computer largely hinges on their personal interest and technological preparation. In this regard, professional development activities can help enrich teachers' knowledge and raise their interest. Empowered by the technology skills, more teachers are willing to buy a home personal computer. The establishment of school support and teacher commitment can lead to a more effective use of the Internet resources, and thus, contribute to a closure of the digital divide at rural schools.

Within the setting of rural schools, this investigation further reveals significant differences in the Internet use among teachers who have the computer access at more than one location (Table 2). While teachers' ownership of a personal computer provides a convenient Internet access at home, rural schools can still make more computers available to teachers at multiple locations, such as libraries, instructional labs, offices, and classrooms. By making the Internet connections convenient at both places, teachers can treat the cyberspace resources like their local reference materials from libraries and classrooms.

In summary, results of this investigation clearly support school initiatives that help teachers gain the Internet access at home and in the school. School technology upgrading can add more computers available to teachers at various locations. Professional development activities can empower teachers with the needed knowledge base and technical skills, and thus, lead them to appreciate the convenience of Internet access according to their own schedule. On basis of the empirical data from this study, the joint effort between the school and teacher levels is likely to help narrow the digital divide in the rural, underserved regions.

Footnotes

[1] The six schools or school districts involved in this investigation are Carbool, Fair Play, Miller, Shell Knob, Study, and Wheaton in the Ozarks region of Missouri.

[2] On July 20, 2000, a total of 198 web sites cited using the StaR chart instrument in states of California, Colorado, Florida, Illinois, Indiana, Iowa, Kansas, Louisiana, Massachusetts, Michigan, Missouri, Ohio, Pennsylvania, South Carolina, Texas, Virginia, Wisconsin.

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